Tool For Friction Stir Tack Welding of Aluminum Alloys

The same setup can be used for tack welding and full friction stir welding.

Marshall Space Flight Center, Alabama

A small friction-stir-welding tool has been developed for use in tack welding of aluminum-alloy workpieces. It is necessary to tack-weld the workpieces in order to hold them together during friction stir welding because (1) in operation, a full-size friction-stir-welding tool exerts a large force that tends to separate the workpieces and (2) clamping the workpieces is not sufficient to resist this force.

It is possible to tack the pieces together by gas tungsten arc welding, but the process can be awkward and time-consuming and can cause sufficient damage to necessitate rework. Friction stir tack welding does not entail these disadvantages. In addition, friction stir tack welding can be accomplished by use of the same automated equipment (except for the welding tool) used in subsequent full friction stir welding.

The tool for friction stir tack welding (see figure) resembles the tool for full friction stir welding, but has a narrower shoulder and a shorter pin. The shorter pin generates a smaller workpiece-separating force so that clamping suffices to keep the workpieces together. This tool produces a continuous or intermittent partial-penetration tack weld. The tack weld is subsequently consumed by action of the larger tool used in full friction stir welding tool.

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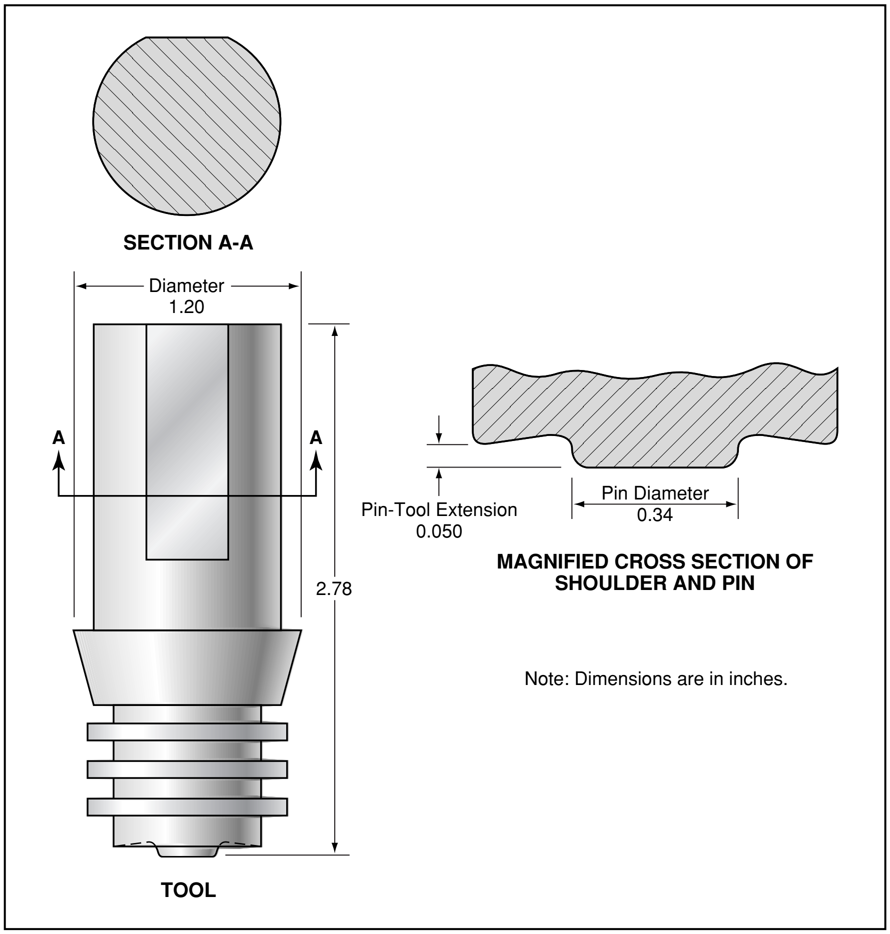

This **Friction-Stir-Welding Tool** is designed specifically for tack welding of 0.32-in. (8.1-mm)-thick pieces of aluminum-lithium alloy 2195. Different values of pin-tool extension and shoulder diameter might be needed for optimum tack welding of different alloys or different thicknesses.

Improving Plating by Use of Intense Acoustic Beams

This method affords enhanced capabilities for maskless plating and process control.

John H. Glenn Research Center, Cleveland, Ohio

An improved method of selective plating of metals and possibly other materials involves the use of directed high-intensity acoustic beams. The beams, typically in the ultrasonic frequency range, can be generated by fixed-focus transducers (see figure) or by phased arrays of transducers excited, variously, by continuous waves, tone bursts, or single pulses. The nonlinear effects produced by these beams are used to alter plating processes in ways that are advantageous.

One of the nonlinear effects is acoustic streaming, which can contribute to selective plating of an object immersed in a plating solution by providing fresh plating solution to the portion of the object at or near the focus of a beam. The combination of acoustic streaming and acoustic-radiation pressure is effective in removing debris and bubbles, which, if allowed to remain, can contaminate the plating material and/or inhibit the plating process. Acoustic streaming can also be used to reduce concentrations and gradients of concentrations of gases (especially hydrogen) in order to prevent the formation of bubbles. Acoustic streaming can be utilized further to counteract effects of localized electric fields and of gradients of concentration of the plating solution that can give rise to undesired components of spatial nonuniformity in the plating process.

Another nonlinear effect is heating of the plating solution in the focal region. The local increase in temperature causes a local increase in the rates of chemical reactions and thus in the rate of deposition of plating material.

As an alternative to the immersion form of selective plating, acoustic streaming can be utilized to create a fountain of plating solution, which strikes a selected small area of a part suspended over a pool of plating solution. Plating occurs only on the